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ROCKY FLATS FIELD OFFICE
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GOLDEN, COLORADO 80402-0928

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Uhland, J	X	

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Reviewed for Addressee
Corres. Control RFP

2/11/98 SK
Date By

Ref Ltr. #

DOE ORDER # 5400.1

Mr. Tim Rehder
U.S. Environmental Protection Agency, Region VIII
Rocky Flats Project
999 18th Street, Suite 500
Denver, Colorado 80202-2466

Dear Mr. Rehder:

Enclosed for your review and approval are copies of the "Sampling and Analysis Plan Characterization and Conceptual Design 903 Pad/Ryan's Pit and East Trenches Plumes", dated February 1998. The purpose of the plan is to direct the collection of field data necessary to delineate the extent of groundwater contamination in areas of potential impact to surface water in the downgradient portions of the 903 Pad/Ryan's Pit and the East Trenches plumes. These data will provide input for decisions regarding the need for and/or type of remedial actions to contain and treat contaminated groundwater from these plumes. DOE and Kaiser-Hill has scheduled a meeting to discuss the plan with your agency and the Colorado Department of Public Health and Environment on Tuesday, February 17, 1998 at your offices.

If you should have any technical questions regarding this transmittal, please call Norma I. Castaneda at 966-4226 or contact me at 966-4839.

Sincerely,

Steven W. Slaten
RFCA Project Coordinator

Enclosure

cc w/Enc:
R. Greenberg, EM-45, HQ
G. Kleeman, EPA
C. Spreng, CDPHE
Administrative Record

cc w/o Enc:
S. Tarlton, CDPHE
S. Gunderson, CDPHE
J. Legare, AMEC, RFFO
B. April, RLG, RFFO
R. Tyler, ER/WM, RFFO
N. Castaneda, ER/WM, RFFO
J. Uhland, K-H

FEB 1998

ADMIN RECORD
BZ-B-00001

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ER/WM&I DDT

Source/Driver: (Name & Number from ISP, IAG milestone, Mgmt. Action, Corres. Control, etc.)	Closure #: (Outgoing Correspondence Control #, if applicable)	Due Date
J. K. Hopkins/A. L. Primrose	G. DiGregorio	J. E. Law
Originator Name	**QA Approval**	**Contractor Manager(s)**
J. Uhland		A. D. Rodgers
Kaiser-Hill Program Manager(s)		**Kaiser-Hill Director**

Document Subject:

TRANSMITTAL OF THE DRAFT SAMPLING AND ANALYSIS PLAN FOR CHARACTERIZATION OF THE 903 PAD/RYAN'S PIT AND EAST TRENCHES PLUMES - JEL-026-98

KH-00003NS1A February 9, 1998

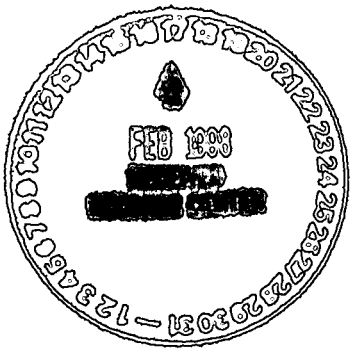
Discussion and/or Comments:

Please find enclosed four (4) copies of the ***Draft Sampling and Analysis Plan for Characterization of the 903 Pad/Ryan's Pit and east Trenches Plumes*** for your review and approval. Included are two (2) copies for Kaiser-Hill and two (2) copies for the Department of Energy. Upon notification from the DOE, we will have four (4) additional copies (two each) delivered directly to the EPA and the CDPHE.

Please contact Annette Primrose at extension 4385 if you have any questions.

Attachments:
As Stated

cc:
A. C. Crawford
J. K. Hopkins
J. E. Law
A. L. Primrose
Administrative Record
RMRS Records



IT-DNV/RMRS-98- 001-003

INTERNATIONAL TECHNOLOGY CORPORATION

FEBRUARY 1998

SAMPLING AND ANALYSIS PLAN CHARACTERIZATION AND CONCEPTUAL DESIGN 903 PAD/RYAN'S PIT AND EAST TRENCHES PLUMES

Prepared for:
ROCKY MOUNTAIN REMEDIATION SERVICES, LLC
GOLDEN, COLORADO

Prepared by:

INTERNATIONAL TECHNOLOGY CORPORATION

IT CORPORATION
DENVER, COLORADO

RESPONSIVE TO THE NEEDS OF ENVIRONMENTAL MANAGEMENT

IT-DNV/RMRS-98- 001-003

FEBRURAY 1998

SAMPLING AND ANALYSIS PLAN CHARACTERIZATION OF THE 903 PAD/RYAN'S PIT AND EAST TRENCHES PLUMES

Prepared for:
ROCKY MOUNTAIN REMEDIATION SERVICES, LLC
GOLDEN, COLORADO

Prepared by:

IT CORPORATION
DENVER, COLORADO

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1.0 INTRODUCTION

The purpose of this Sampling and Analysis Plan (SAP) is to direct the collection of field data necessary to delineate the extent of groundwater contamination in areas of potential impact to surface water in the downgradient portions of the 903 Pad/Ryan's Pit and the East Trenches plumes. These data will provide input for decisions regarding the need for and/or type of remedial actions to contain and treat contaminated groundwater from these plumes. The 903 Pad/Ryan's Pit and East Trenches groundwater plumes are ranked second and third, respectively, in terms of priority and sequence with respect to proposed implementation of groundwater cleanup actions [revised Attachment 4 to the Rocky Flats Cleanup Agreement (RFCA) (DOE, 1996)].

The objective of the SAP is to describe the specific data needs, sampling and analysis requirements, data handling procedures, and associated Quality Assurance/Quality Control (QA/QC) requirements for this project. All work will be performed in accordance with the RMRS Quality Assurance Program Description (QAPD) (RMRS, 1997a). The SAP summarizes the existing data and describes the work required to better define the nature and extent of contamination in the two areas to determine if remedial action is required and to develop conceptual designs for remedial action if necessary.

1.1 Background

The background information presented in this section is based primarily on the Operable Unit (OU) 2 Phase II RFI/RI investigation (DOE, 1995) and the Groundwater Conceptual Plan (RMRS, 1996). The history of the major sources affecting the groundwater contaminant plumes is discussed.

1.1.1 903 Pad/Ryan's Pit Plume

Two nearby sources contribute to the 903 Pad/Ryan's Pit Plume. The 903 Pad is an area where drums of waste were stored. To the south of the 903 Pad is Ryan's Pit, where a small trench was used as a waste disposal site (Figure 1).

The 903 Pad area was used to store drums that contained radioactively contaminated oils and VOCs from the summer of 1958 to January 1967. Approximately three-quarters of the drums contained plutonium-contaminated liquids while most of the remaining drums contained uranium-contaminated

liquids. Of the drums containing plutonium, the liquid was primarily lathe coolant and carbon tetrachloride in varying proportions. Also stored in the drums were hydraulic oils, vacuum pump oils, trichloroethene, tetrachloroethene, silicone oils, and acetone still bottoms.

Leaking drums were noted in 1964 during routine handling operations. The contents of the leaking drums were transferred to new drums, and the area was fenced to restrict access. When cleanup operations began in 1967, a total of 5,237 drums were at the drum storage site. Approximately 420 drums leaked to some degree. Of these, an estimated 50 drums had leaked their entire contents. The total amount of leaked material was estimated at around 5,000 gallons of contaminated liquid containing approximately 86 grams of plutonium. From 1968 through 1969, some of the radiologically contaminated material was removed, the surrounding area was regraded, and much of the area was covered by clean road base and an asphalt cap. Dense, nonaqueous phase liquids (DNAPLs) are suspected to exist underneath the 903 Pad, as high concentrations of VOCs are present in the groundwater (greater than 1% of the chemical's solubility).

Ryan's Pit is located approximately 150 feet south of the 903 Pad and is approximately 20 feet long, 10 feet wide, and five feet deep. Ryan's Pit was used as a waste disposal site from 1969 and 1971 for nonradioactive liquid chemical disposal. VOCs disposed at this location included tetrachloroethene, trichloroethene, and carbon tetrachloride. In addition to VOC disposal, paint thinner and small quantities of construction-related chemicals may also have been placed in Ryan's Pit. According to historical data, only the liquids themselves were put in the pit; their containers were either reused or disposed of in other areas (DOE, 1992).

Contaminated soils were removed and treated during the 1995 removal action at Ryan's Pit. Free phase tetrachloroethene and motor fuel constituents were found during this removal action, along with degraded drums and plutonium contaminated soils.

1.1.2 East Trenches Plume

A large plume of contaminated groundwater is located in the East Trenches area, primarily associated with the trenches on the north side of the East Access Road which include Trenches T-3 (IHSS 110) and T-4 (IHSS 111.1). Upgradient wells indicate a component of the contaminated groundwater in this area is derived from the VOC contamination at the 903 Pad. However, the VOC concentrations in

groundwater increase over 100 times after the groundwater passes through Trenches T-3 and T-4, indicating a VOC source is present (DOE, 1995).

Trench T-3 is located approximately 300 feet north of the East Access Road and immediately west of Trench T-4. Trench T-3 is approximately 134 feet long, 20 feet wide and 10 feet deep. Trench T-4 is approximately 110 feet long, 15 feet wide, and 10 feet deep. The trenches were reportedly used sometime between 1954 to 1968 for disposal of sanitary sewage sludge, potentially contaminated with uranium and plutonium, and flattened empty drums contaminated with uranium. The trenches are also known to have contained DNAPLs, crushed drums, and other miscellaneous waste. Both trenches were excavated as a source removal action in 1996. Soils were treated to remove VOC contamination and were returned to the trenches.

1.2 Prior Investigations and Conceptual Model

Subsurface investigations of contamination associated with these plumes were underway as early as 1987. The following information is derived from recent summaries of those investigations (DOE, 1995; RMRS, 1996).

1.2.1 903 Pad/Ryan's Pit Plume

The 903 Pad is located on the flat surface at the southern edge of the pediment. A south facing hillside slopes downward from the 903 Pad to the SID and Woman Creek. Ryan's Pit is located on the hillside to the south of the 903 Pad. In the 903 Pad area, the Rocky Flats Alluvium is 10 feet thick at the northwest corner of the Pad which is near a bedrock high, and 25 feet thick at the southeast corner which is within a bedrock channel. The 903 Pad is paved with asphalt, and artificial fill is present under the 903 Pad and covers a large area to the south and east of the Pad.

The Rocky Flats Alluvium is truncated by erosion and does not extend to Ryan's Pit. The Ryan's Pit surficial deposits consist of reworked Rocky Flats Alluvium that has been transported down slope, along with other clay-rich colluvium deposits and fill material. Surficial deposits consist of colluvium between one and eight feet thick which is primarily clay, and silty or sandy clay. Caliche is common in both the alluvium and colluvium. Groundwater at Ryan's Pit is between 3 to 10 feet below ground surface. On the slope, there are numerous slump features, and a large scarp face is located between the 903 Pad and Ryan's Pit.

Bedrock in the 903 Pad and Ryan's Pit area is primarily composed of weathered claystone of the Arapahoe and Laramie Formations. In addition, the Arapahoe No. 1 Sandstone subcrops under the alluvium at the extreme northwest corner of the 903 Pad. This sandstone is continuous with the Arapahoe No. 1 Sandstone at the Mound Site, where it is truncated by the South Walnut Creek drainage. The geometric mean for the Rocky Flats Alluvium hydraulic conductivity is 6×10^{-4} cm/sec. The geometric mean for the Arapahoe No. 1 Sandstone hydraulic conductivity is 7×10^{-4} cm/sec. The geometric mean for unweathered bedrock is 8×10^{-8} cm/sec. Infiltration of groundwater into the underlying unweathered claystone is limited (DOE, 1995).

Groundwater flow is complex and is primarily controlled by bedrock surface features, interactions between geologic units, and variations in saturated thicknesses. Groundwater flow paths in alluvial materials in the 903 Pad and Ryan's Pit area are relatively well-defined by contact seeps with the underlying bedrock materials and by numerous wells. However, groundwater flow through the hillside colluvium and bedrock is poorly understood. Areas of unsaturated colluvium are common and prediction of local flow paths is difficult. Depending on the season, there may be many unsaturated areas within the plume. Discharge of contaminated groundwater has not been observed from the colluvium or weathered bedrock portion of this plume.

A large bedrock low (paleoscour) extends from the 903 Pad east and passes directly south of the northern East Trenches. This paleoscour is bounded by bedrock highs to the north and south. Near the 903 Pad, there is 20 to 25 feet of relief between the paleoscour and the northern bedrock high, and 5 to 10 feet of relief between the paleoscour and southern bedrock high. The paleoscour directs groundwater flow to the east till it is truncated by the South Walnut Creek drainage where alluvial groundwater discharges into the head of a well-developed gully. Groundwater flow from the 903 Pad towards the SID and Woman Creek also occurs either by overtopping of the lower, southern bedrock high, or through breaks in the bedrock high. During dry periods, the bedrock highs restrict alluvial groundwater flow to the south and north. During wet periods, when the alluvial groundwater levels are very high, flow may overtop these barriers, primarily to the south (DOE, 1995).

Groundwater flow in the colluvium follows north-south trending small paleochannels cut into the underlying bedrock claystone. One narrow paleochannel, approximately 150 to 300 feet wide, extends

from the 903 Pad south through Ryan's Pit. The areas surrounding these paleochannels is unsaturated. The southern extent of groundwater flow is not well defined due to lack of well control.

Recharge is primarily from infiltration of precipitation along with some recharge from ditches and other surface water features. Wells located to the west of the 903 Pad are generally dry as alluvial groundwater inflow from the west is restricted by the claystone bedrock high just west of the 903 Pad. Unconsolidated materials within the medial portion of the paleoscour tend to be saturated, with the extent of saturation greatest during the spring. Groundwater flow occurs through the No. 1 Sandstone until it subcrops beneath the colluvium. Discharge is primarily to seeps located where the water bearing units are truncated by the South Walnut Creek drainage.

The 903 Pad and Ryan's Pit Plume is defined as the lobe of contaminated groundwater that flows southward from these two source areas. This plume flows southward toward the South Interceptor Ditch (SID) and Woman Creek drainage. The lobe of contaminated groundwater which flows eastward from the 903 Pad is addressed as part of the East Trenches Plume.

Contaminated groundwater in the 903 Pad and Ryan's Pit area is primarily confined to the alluvium and colluvium. Total VOC concentrations for the Arapahoe No. 1 Sandstone are approximately 2,500 ug/l adjacent to the west edge of the 903 Pad with concentrations at other locations less than 2 ug/l or non-detect. Fifty-seven VOCs were detected in groundwater of the upper hydrostratistraphic unit (UHSU). However, the primary contaminants are carbon tetrachloride, tetrachloroethene, and trichloroethene. The southern component of the contaminant plume derived from the 903 Pad contains total VOCs in the 5,000 ug/l range near the 903 Pad, diminishing to 1,500 to 2,000 ug/l range upgradient of Ryan's Pit. Downgradient of Ryan's Pit, the total VOC concentration in groundwater ranges from 57,000 ug/l near Ryan's Pit to 5 ug/l near the distal end of the plume approximately 600 feet downgradient. The total VOC concentration in contaminated groundwater from the 903 Pad which does not also flow through the Ryan's Pit source is also estimated at 5 ug/l when it nears the Woman Creek drainage (DOE, 1995).

The highest concentrations of many VOC contaminants in the former OU 2 area are located within this plume. The highest concentration of tetrachloroethene (150,000 ug/l) was detected immediately downgradient of Ryan's Pit and occurred with 1,1-dichloroethene at 380 ug/l. A well installed through

the center of the 903 Pad contained concentrations of carbon tetrachloride in groundwater at 20,000 ug/l, chloroform at 39,000 ug/l and methylene chloride at 35,000 ug/l. A well installed at the northeast corner of the Pad detected tetrachloroethene at 14,000 ug/l.

A limited number of wells are located in the distal portion of the 903 Pad/Ryans's Pit Plume. Available data from these wells indicate the possibility that contaminated groundwater may discharge to the SID and Woman Creek surface water pathways.

1.2.2 East Trenches Plume

In the East Trenches plume area, Trench T-3 and T-4 are located at the northern edge of the pediment where up to 18 feet of Rocky Flats Alluvium overlies fractured claystone and the No. 1 Sandstone of the Arapahoe Formation. Beyond the pediment boundary, the topography slopes steeply to the north towards South Walnut Creek. Both the alluvium and the Arapahoe No. 1 Sandstone are truncated by the South Walnut Creek drainage.

The unconsolidated surficial deposits consist of the Rocky Flats Alluvium and artificial fill in the trenches and are generally dry. The Rocky Flats Alluvium consists of beds and lenses of poorly to moderately sorted clayey and silty gravels and sands interbedded with clay and silty lenses or beds. Thickness of the alluvium is approximately 18 feet at Trench T-4 and 16 feet at Trench T-3. Below the outcrop of the contact between the Rocky Flats Alluvium and the underlying Arapahoe Formation, the slope is covered with unconsolidated colluvium primarily composed of clay, or silty and sandy clay. Caliche is common in both alluvium and colluvium. On the slope, there are numerous slump features.

Underlying the alluvium to the north of the trenches is the continuation of the claystone bedrock high from the 903 Pad Area. A paleoscour runs beneath in an east-west direction to the south of Trenches T-3 and T-4. This feature directs shallow groundwater flow to the east, away from South Walnut Creek. The Arapahoe No. 1 Sandstone subcrops beneath the eastern portion of Trench T-3 and most of Trench T-4. This fluvial sandstone is incised into the surrounding bedrock claystone and consists of sandstone, clayey sandstone, and silty sandstone. The channel of the Arapahoe No. 1 Sandstone is approximately 40 feet thick and mostly saturated. Groundwater flow is generally unconfined, and flow within the channel is northward towards South Walnut Creek. The sandstone subcrops beneath the colluvium between the trenches and South Walnut Creek at a spring and seep complex.

The geometric mean for the Rocky Flats Alluvium hydraulic conductivity is 6×10^{-4} cm/sec. The geometric mean for the Arapahoe No. 1 Sandstone hydraulic conductivity is 7×10^{-4} cm/sec and the geometric mean for unweathered bedrock is 8×10^{-8} cm/sec. Infiltration of groundwater into the underlying unweathered claystone is limited (DOE, 1995).

Recharge of the Rocky Flats Alluvium is primarily through infiltration of precipitation, and upgradient flow from within the paleoscour. Recharge to the Arapahoe No. 1 Sandstone is from infiltration of precipitation through the surficial deposits, and some flow from upgradient. Discharge is primarily to seeps, springs, and evapotranspiration in the area where the water bearing units are truncated along the banks of South Walnut Creek.

Contaminated groundwater occurs in the alluvium and in the Arapahoe No. 1 Sandstone that is in hydraulic connection with the alluvium. While 27 VOCs were detected within the UHSU groundwater, the majority were detected at concentrations below 100 ug/l. The major contaminants in groundwater are trichloroethene (maximum source area value of 94,000 ug/l), carbon tetrachloride (maximum source area value of 4,500 ug/l), and tetrachloroethene (maximum source area value of 1,000 ug/l). During the Soil Vapor Extraction Pilot Test Project, stratified water/NAPL samples were collected and analyzed from Trench T-3. These samples contained high levels of VOCs (up to 37,000,000 ug/l for tetrachloroethene) along with semivolatiles, petroleum compounds, and uranium-238 (at concentrations up to 3,240 pCi/g). In addition, borehole soil samples collected from T-4 contained 12,000 ug/kg tetrachloroethene and 1,000 ug/kg trichloroethene (RMRS, 1997a).

The downgradient boundary of the contaminant plume is located at a spring and seep complex on the south bank of South Walnut Creek, above Ponds B-1 and B-2, where the Arapahoe No. 1 Sandstone subcrops. Concentrations of VOCs above Tier I action levels have been detected by a recent sampling program. The presence of VOCs in the seep complex indicates that contaminants from the groundwater plume have reached South Walnut Creek.

A lobe of this contaminant plume extends to the east of the East Trenches area along the paleoscour. Alluvial groundwater discharging downgradient of this lobe as seeps in an unnamed tributary drainage to South Walnut Creek appears to be uncontaminated.

Geoprobe borings were advanced at the East Trenches plume as part of the RFETS FY97 Well Abandonment and Replacement Program (WARP). The geoprobe borings were located at 100-foot intervals along a southwest-northeast alignment immediately north of the road on the south bank of South Walnut Creek, above Ponds B-1 and B-2. The geoprobe borings have partially defined the extent of groundwater contamination along the south bank of South Walnut Creek. Evaluation and interpretation of data obtained from this recent investigation is currently in progress.

1.3 Contamination Data Summary

The areas of investigations are located downgradient from the sources of the plumes, near potential areas of discharge to surface water pathways. This field investigation will provide additional data in the vicinity of the plume fronts to determine suitable groundwater management actions to protect surface water from the groundwater plumes.

1.3.1 903 Pad/Ryan's Pit Plume

The concentrations of major constituents of the VOC plume in groundwater from wells located near the 903 Pad/Ryan's Pit downgradient plume boundary are provided in Table 1 and shown in Figure 2. The apparent plume extent shown in Figure 2 is from the 1996 RFCA Groundwater Monitoring Report (RMRS, 1997b). Concentrations in several wells along the plume front exceed Tier II action levels for one or more VOC.

Table 1. Downgradient Groundwater Concentrations – 903 Pad/Ryan's Pit Plume

Contaminant	Well 6286	Well 6386	Well 1487	Well 23196	Well 01291	Groundwater Tier II Action Levels
Carbon Tetrachloride	8	ND	460	ND	15	5
Cis-1,2-Dichloroethene	ND	ND	ND	ND	0.2	70
Methylene Chloride	ND	ND	ND	ND	0.5	6
Tetrachloroethene	ND	ND	8	ND	2	5
Trichloroethene	0.8	ND	190	ND	12	5

Note: all values are maximum concentrations (ug/l) from 1996 samplings of monitoring wells; ND indicates not detected or below detection limit (RMRS, 1997b)

1.3.2 East Trenches Plume

In 1997, 22 wells were installed in geoprobe borings as part of the WARP Program. The groundwater concentrations of major VOCs in groundwater from these WARP wells and nearby wells in the vicinity of the East Trenches downgradient plume front are provided in Table 2 and shown in Figure 3. Consistent with their locations downgradient from the source areas, Tier I action levels are generally not exceeded, but groundwater concentrations do exceed Tier II action levels at many locations along the plume front. The apparent plume extent shown in Figure 3 is from the 1996 RFCA Groundwater Monitoring Report (RMRS, 1997b).

Table 2. Downgradient Groundwater Concentrations – East Trenches Plume

Contaminant	Well 22997	Well 22697	Well 23197	Well 23296	Groundwater Tier II Action Levels
Carbon Tetrachloride	460 ug/l	71 ug/l	140 ug/l	ND	5 ug/l
1,1,1-Trichloroethane	440 ug/l	730 ug/l	190 ug/l	7	200 ug/l
Trichloroethene	280 ug/l	41 ug/l	6,800 ug/l	340	5 ug/l

Note: all values are observed concentrations (ug/l) from FY97 WARP sampling
ND indicates not detected or below detection limit

2.0 PROJECT AND DATA QUALITY OBJECTIVES

The objective of this SAP is to characterize the depth, volume, and extent of the 903 Pad /Ryan's Pit and the East Trenches contaminated groundwater plumes sufficiently to determine the need for future remedial actions and if necessary, to allow planning for specific actions. Data quality objectives to support this project were developed using criteria established in *Guidance for the Data Quality Objective Process*, EPA QA/G-4 (EPA, 1994). The data gaps, study boundaries, and decisions are described below.

Groundwater action levels are specified in RFCA (DOE, 1996) and are intended to prevent contamination of surface water by applying action levels to groundwater which are protective of surface water and ecological resources. These groundwater action levels are based on maximum contaminant levels (MCLs) and applied using a two-tiered approach. Tier I action levels are 100 times the MCLs and are designed to identify sources of groundwater contamination that should be addressed through accelerated actions. Tier II action levels consist of MCLs and are designed to prevent surface water from exceeding surface water standards by triggering groundwater management actions when necessary.

In the case of the 903 Pad/Ryan's Pit Plume, data gaps exist at numerous locations along the plume front due to the relatively few number of monitoring wells in the area. At the East Trenches plume, the data gaps occur primarily at the lateral margins of the plume front, beyond the limits of the FY97 WARP geoprobe wells. The spatial distribution of gaps in hydrogeologic and chemical data are evident in Figures 2 and 3 by the locations in the vicinity of the plume front where monitoring wells are lacking. The following data gaps have been identified:

- Lateral and vertical extent of the VOC plumes above Tier II action levels,
- Bedrock topography in the plume front areas, near surface water pathways,
- Data to determine the proper disposition of excavated soils from potential remediations.

The study boundaries are confined to alignments of borings approximately parallel to the SID, South Walnut Creek and Woman Creek surface water pathways (Figures 2 and 3). The alignments are intended to transect the 903 Pad/Ryan's Pit front and extend the alignment of the geoprobe borings in the East Trenches plume front to sufficiently address the data gaps. The investigation results, together

with results from the prior investigations, will be used to reach decisions regarding potential remedial actions for the plumes.

Approximately 22 geoprobe borings will be advanced at 50 to 100-foot intervals along a 1400-foot alignment near the downgradient front of the 903 Pad/Ryan's Pit plume, north of the SID (Figure 2). The average depth to bedrock in this area is estimated to be 12 feet. Approximately 8 geoprobe borings will be advanced at intervals generally approximating 100 feet along extensions southwest and northeast of the previous geoprobe work in the East Trenches plume (Figure 3). One boring is planned at the southwest limit of the previous work, where the average bedrock depth is estimated to be 11 feet, and seven borings are planned at the northeast limit of the previous work, where the average bedrock depth is estimated to be approximately 20 feet.

Both subsurface soil samples and groundwater samples will be collected as possible. Subsurface soil samples will be collected using geoprobe push-type hydraulic equipment. Table 3 lists the projected number of samples to be collected, analyses, and sampling requirements. Quality Control (QC) samples will be collected with a frequency of at least one per 20 field samples. The Analytical Services Division (ASD) will provide sample containers.

Table 3. Analytical Sampling Requirements

Analysis Method	Number of Samples	Number of QC Samples	Total Number Samples	Containers, Preservatives, Holding Times
Soils SW846 Method 8260A (EPA, 1992)	30	2 duplicate 2 rinsate		60 ml wide mouth, Teflon lined, glass jar, 4° C, 14 days
Alpha Spectroscopy for Uranium 233/234, 234 & 238, Plutonium 239/240 and Americium 241	5	1 duplicate	40	250 ml glass jar, NA, 6 months
Groundwater SW846 Method 8260A (EPA, 1992)	30	2 duplicate 2 rinsate 5 trip blanks (1 per shipment)	39	Three 40 ml Teflon lined VOA vials per sample with septum lids, HCl* to pH < 2 and 4° C, 14 days

* For safety reasons, if there is any reason to believe the sample contains NAPL, acid will not be put into the sample jars, and contact between the sample and any form of acid will be avoided.

Core samples will be recovered continuously in two to five-foot increments and evaluated by a geologist familiar with the local stratigraphy. Soil samples will be collected from the recovered soil cores and analyzed for a variety of contaminants to support the proper disposition of the soil removed during subsequent remediation activities (Section 3.2). The geologist will determine the depth to bedrock. The geoprobe locations will be surveyed using Global Positioning System (GPS) equipment or other appropriate survey equipment.

At each location, after the core has been collected, a temporary slotted PVC liner will be installed in accordance with GT.06 Monitoring Well and Piezometer Installation, and any water within the well will be allowed to equilibrate overnight. If there is insufficient water for sampling, the well will be observed weekly during the rest of the field investigation. If water is detected, the depth to water from the land surface will be measured so that thickness and extent of saturated alluvium can be determined.

If a sufficient amount of water is detected, a groundwater sample will be collected for VOC analysis. These samples will be used to determine to what extent the groundwater within the study area contains VOCs in excess of the Tier II Ground Water Action Levels established by the RFCA (DOE, 1996). This method will provide a detection limit below the Tier II levels described above, for the predominant VOCs.

Characterization data acquired through implementation of the geoprobe boring and well installation program will be combined with existing data and used to support the primary technical decisions as follows;

- What are the concentrations of VOC and radionuclide contamination in the soil and groundwater at each boring location,
- Is groundwater present at the boring location and if so what is the water table elevation,
- What is the depth to bedrock at each boring location,
- Can the vertical and horizontal extent be determined from review of data associated with this characterization project and existing data,
- How does the plume configuration change and does this effect the RFETS goal to limit the potential for groundwater which exceeds Tier II concentrations from entering surface water?

3.0 SAMPLING AND ANALYSES

Data will be collected and combined with existing data to determine the appropriate remedial action. Thirty geoprobe holes will be located at the distal ends of the two plumes in order to refine the nature and extent of the plumes, and to identify depth to bedrock.

Figure 2 and 3 show the approximate locations of the planned geoprobe holes. It is anticipated that some locations may need to be changed due to access limitations or obstructions, particularly along the northeast extension of the geoprobe alignment in the East Trenches plumes. Additional changes in locations may be made to avoid slump structures or to place borings in drainages where saturated soils may be expected. Any location changes will be marked in the field, noted in the field logbook, and cleared and documented before drilling. The sampling requirements for each type of sample event to be performed under this SAP are described in Table 3 and in the following sections.

Samples will be handled according to FO.10 Receiving, Labeling, and Handling Environmental Material Containers, and FO.13 Containerization, Preserving, Handling and Shipping of Soil and Water Samples. All samples will have an identification number generated by the RFETS SD. If conditions are encountered in the field which make the use of a procedure unsafe or inappropriate for the task at hand, the specified procedures may be modified or replaced as long as the modification or replacement procedure is justified and appropriately documented.

3.1 Field Preparation

Before data collection begins, each geoprobe location will be established using tape and compass, and marked with a reference stake or flag with the unique number for that location. Locations will be cleared in accordance with GT.10 Borehole Clearance. The geoprobe location number will be obtained from the Soil and Water Database (SWD) and correlated with sample analyses for that location. These installed geoprobe wells will be surveyed for location and elevation using GPS receivers operated in accordance with the equipment manuals (Ashtech, 1993), or other appropriate survey equipment.

3.2 Geoprobe Samples

All geoprobe boreholes will be advanced to a depth of two feet into weathered bedrock, or to a sufficient depth to confirm unweathered bedrock, a total depth expected not to exceed 30 feet. If weathered bedrock is Arapahoe No. 1 Sandstone, the boring will be continued if possible up to ten feet below the top of weathered bedrock. If refusal occurs prior to reaching bedrock, up to two offsets will be pushed in an attempt to reach the sampling objectives. Geoprobe operations will be conducted as per GT.39 Push Subsurface Soil Sample.

Core samples will be collected continuously in two to five foot increments from the surface to approximately two feet into bedrock. These core samples will be screened with a field instrument for the detection of low energy radiation (FIDLER) in accordance with F0.16 Field Radiological Measurements, and with a photoionization detector for detection of VOCs in accordance with FO.15 Photoionization Detectors and Flame Ionization Detectors, visually inspected for signs of NAPL or other contaminant staining, and then visually logged by the field geologist per GT.01 Logging Alluvial and Bedrock Material. The depth and thickness of stained or saturated core will be described in detail; however, portions of GT.01 will not be used, e.g., sieving samples, investigation with a binocular microscope, and field estimates of plasticity.

Soil samples will be collected for analyses as described in Table 3 from the geoprobe holes to determine the extent of contamination in the subsurface soils. One sample will be collected for laboratory analysis of VOCs at each boring. If saturated soils are encountered, the VOC sample will be collected from a discrete interval judged on the basis of screening and logging to be relatively transmissive and/or contaminated. If the soils appear to be unsaturated the VOC sample will be collected near the bedrock contact. In every sixth borehole (in the order drilled), a radiological sample will be collected, consisting of a composite sample from the two-foot interval directly above bedrock, or where bedrock is not reached, from the lower portion of the retrieved core. If insufficient material is available for all analyses, VOC samples will be collected first at optimal locations, followed by radionuclides.

3.3 Groundwater Samples

After the geoprobe holes are completed to the required depth, five feet of ¾-inch internal diameter (ID), 0.010-inch slotted, Schedule 40 PVC screen will be threaded onto sufficient Schedule 40 PVC casing

extending 6 inches or more above the ground surface. The screened section will have a threaded cap on the bottom. This assembly will be inserted into the hole to allow for collection of groundwater samples. The screened interval will include the basal portion of the unconsolidated soils and the uppermost portion of weathered bedrock. Longer screens will be used to include a longer interval of bedrock if the boring penetrated Arapahoe No. 1 Sandstone. A filter pack of 16/40 silica sand will be poured around the PVC screen and casing to at least one foot above the slotted screen. Granular bentonite will be poured into the annular space to ground surface to prevent cross contamination. A 1.5-foot section of 1.5-inch ID casing will be manually installed around the aboveground section of the well assembly with granular bentonite poured around the outside of the well assembly. A PVC slip cap will be loosely affixed to the open end of the well assembly to prevent flow down the annulus. A PVC cap will be attached to the 1.5-inch casing for additional protection.

Each geoprobe hole will be checked on the work day following its completion, and the water level will be measured according to GW.01 Water Level Measurements in Wells and Piezometers. If sufficient water exists for sample collection (estimated as at least one foot of standing water), the well will be sampled using the methods specified in GW.06 Groundwater Sampling. If the geoprobe hole is dry or contains less than one foot of groundwater inside the casing, a notation will be made in the field notebook. Water levels will be checked on a weekly basis in those wells that are dry or contain insufficient water for sampling. Wells previously dry which are found to contain sufficient water during the weekly monitoring will be sampled as described above. All water level observations will be noted in the project logbooks. At the end of the field project, the wells will be left for possible use in the planned groundwater management actions.

4.0 DATA MANAGEMENT

A field logbook will be created and maintained for the project by the project manager or their designee in accordance with ADM-05.14 Use of Field Logbooks and Forms. The logbook will be used in conjunction with the appropriate field data forms required by the operating procedures (Table 4) governing the field activities occurring during this project. It is not necessary to duplicate items recorded on field data forms in the field notebook, but if additional clarification of entries on the forms is required, they should be recorded in the field notebook. The field notebook should include time and date information concerning the field activities and a sketch map of actual sample locations. Information not specifically required by the field data forms should be recorded in the field notebook.

Non-analytical data for this project will be collected, entered, and stored in a secure, controlled, and retrievable environment in accordance with RM-06.02 Records Identification and Transmittal. Analytical data will be stored in the ASD records center.

Table 4. Applicable Field and Administrative Standard Operating Procedures

Procedure Number	Procedure Title
RMRS-RM-06.02	Records Identification and Transmittal
2-G32-ER-ADM-08.02	Evaluation of ERM Data for Usability in Final Reports
2-S47-ER-ADM-05.14	Use of Field Logbooks and Forms
5-21000-OPS-FO.3	General Equipment Decontamination
5-21000-OPS-FO.6	Handling of Personal Protective Equipment
5-21000-OPS-FO.7	Handling of Decontaminated Water and Waste Water
5-21000-OPS-FO.10	Receiving, Labeling, and Handling Environmental Material Containers
5-21000-OPS-FO.11	Field Communications
5-21000-OPS-FO.13	Containerization, Preserving, Handling and Shipping of Soil and Water Samples
5-21000-OPS-FO.14	Field Data Management
5-21000-OPS-FO.15	Photoionization Detectors and Flame Ionization Detectors
5-21000-OPS-FO.16	Field Radiological Measurements
5-21000-ER-OPS-GT.01	Logging Alluvial and Bedrock Material
5-21000-ER-OPS-GT.05	Plugging and Abandonment of Boreholes
5-21000-ER-OPS-GT.06	Monitoring Wells and Piezometer Installation
5-21000-ER-OPS-GT.10	Borehole Clearing
5-21000-ER-OPS-GT.39	Push Subsurface Soil Sample
5-21000-ER-OPS-GW.01	Water Level Measurements in Wells and Piezometers
5-21000-ER-OPS-GW.06	Groundwater Sampling

4.1 Project Completion

The results of the investigation will be compiled into a brief data summary including maps. The location and analytical data will be entered into the SWD. At the end of the project, all records and field documentation will be turned over to the records center with the exception of analytical data which will be maintained by the ASD record center. The results of this pre-remedial investigation will be utilized in developing a design for the groundwater collection and treatment systems at these locations.

4.2 Quality Assurance

Analytical data collected in support of this investigation will be evaluated using the guidance established by ADM-08.02 Evaluation of ERM Data for Usability in Final Reports. This procedure establishes the guidelines for evaluating analytical data with respect to precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters. Typically, for precision, the relative percent difference between samples and duplicates is less than or equal to 40% for VOCs in soil and less than or equal to 30% for VOCs in water. Accuracy of the laboratories will be evaluated using standardized methods for laboratory control samples and matrix spike/matrix spike duplicates (percent recovery within applicable acceptance limits). Comparability will be evaluated by using standardized methods for the collection and analysis of samples. Completeness will be evaluated by comparing the proposed sampling program to the field program as completed. A goal of 90% is required.

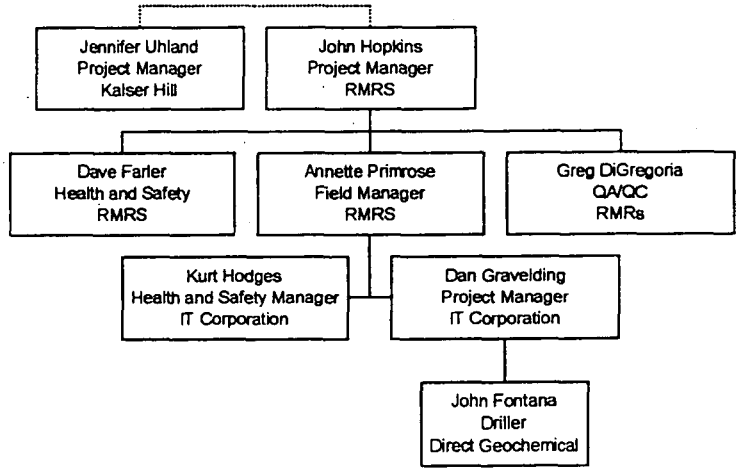
Precision results for radiochemistry will be determined by comparing the results of the laboratory duplicates and the field duplicate with values within a "Duplicate Error Ratio" (DER). The critical DER value separating acceptance or rejection is based on a quality control limit of 1.42, equivalent to a confidence level of approximately 95 percent.

Data validation will be required on 25% of the analytical data validation. An independent third party subcontractor will perform data validation.

5.0 PROJECT ORGANIZATION

The project organization chart is presented in this section. The ER Projects Group is responsible for management and coordination of resources dedicated to the project. Other organizations assisting with the implementation of this project are RMRS Groundwater, RMRS Health and Safety, and RMRS Quality Assurance.

Characterization and Conceptual Design, Project Organization



6.0 REFERENCES

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RMRS, 1997a, RMRS *Quality Assurance Program Description*, RMRS-QAPD-001, Rev. 1, January.

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7.0 LIST OF ACRONYMS

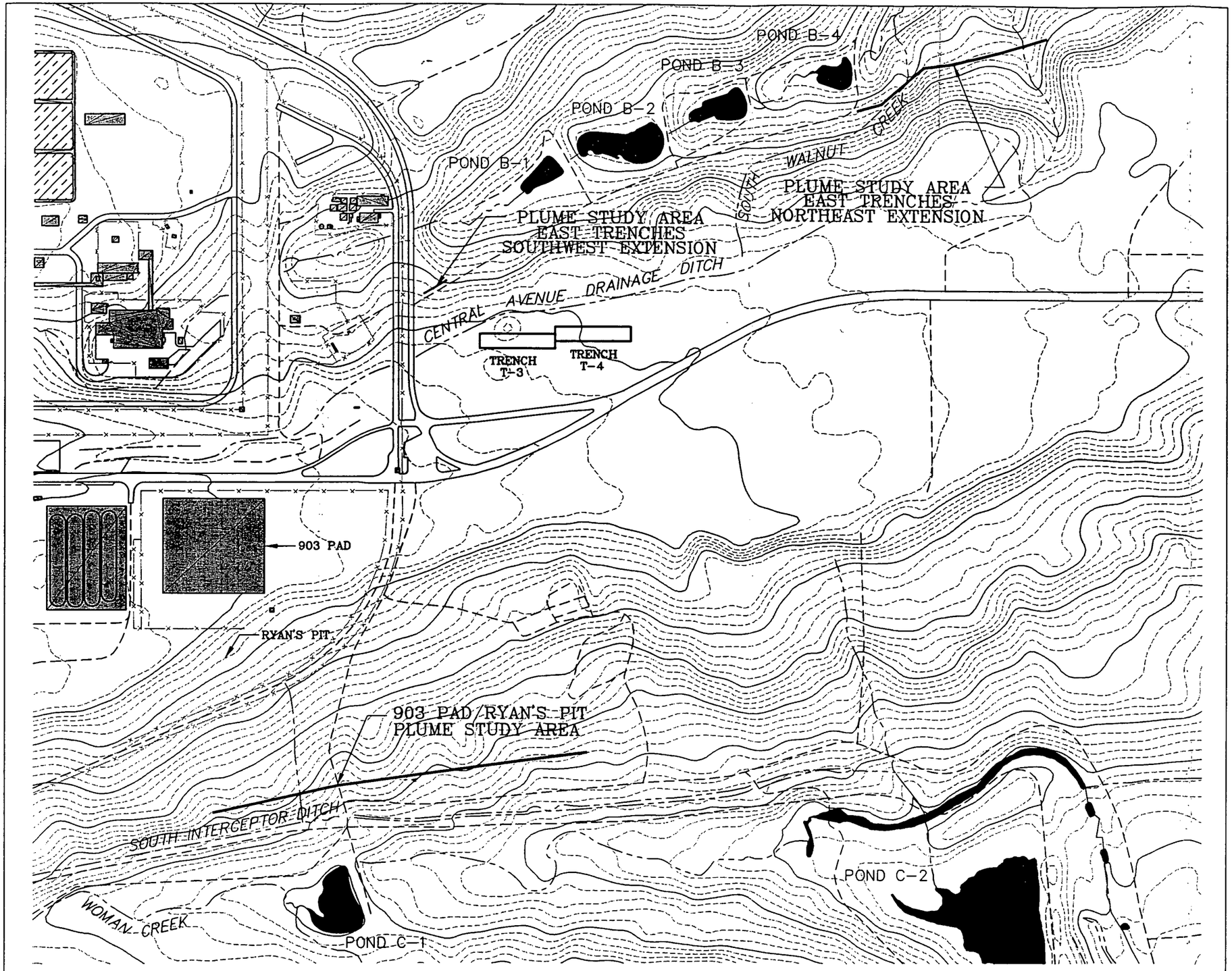
ASD	Analytical Services Division
DNAPL	Dense Nonaqueous Phase Liquid
DOE	Department of Energy
EPA	Environmental Protection Agency
ER	Environmental Restoration
FIDLER	Field instrument for the detection of low energy radiation
GPS	Global Positioning System
IHSS	Individual Hazardous Substance Site
MCL	Maximum contaminant level
OU	Operable Unit
PAM	Proposed Action Memorandum
PID/FID	Photoionization detector/flame ionization detector
QA/QC	Quality Assurance/Quality Control
QAPD	Quality Assurance Program Description
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RMRS	Rocky Mountain Remediation Services
SAP	Sampling and Analysis Plan
SID	South interceptor ditch
SWD	Soil and Water Database
UHSU	Upper hydrostratigraphic unit
VOCs	Volatile organic compounds
WARP	Well Abandonment and Replacement Program

8.0 APPROVALS

_____
Date

_____
Date

_____
Date



LEGEND

- LAKES AND PONDS
- EVAPORATION PONDS
- BUILDINGS AND STRUCTURES
- FENCE OR OTHER BARRIER
- STREAMS AND DITCHES
- 25 FOOT CONTOUR
- 5 FOOT CONTOUR
- PAVED ROAD
- DIRT ROAD

GRAPHIC SCALE
0 100 200 400
(IN FEET)
1 inch = 400 ft.

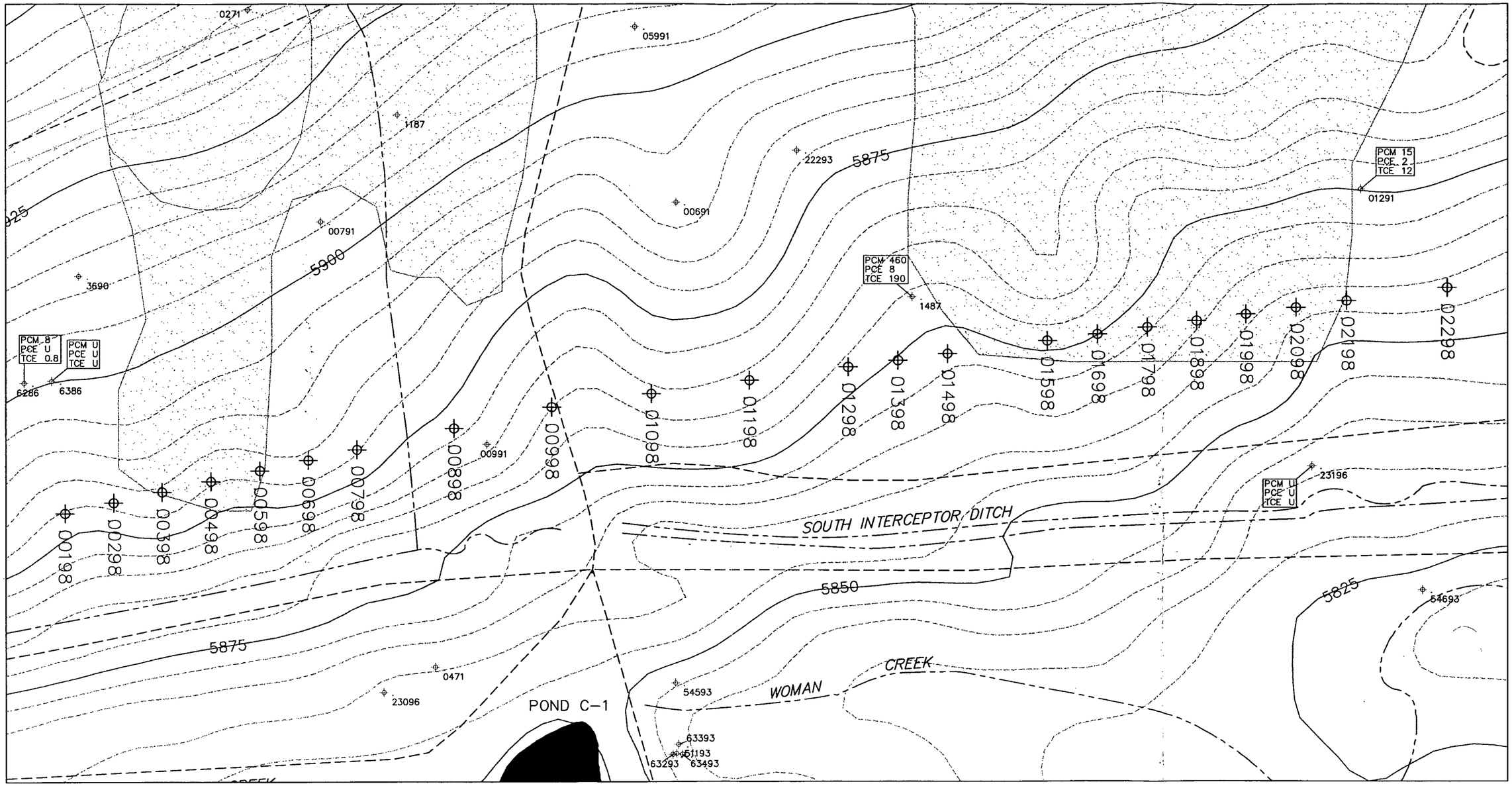
PREPARED FOR:
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
Golden, Colorado

FIGURE 1

TITLE:
903 PAD/RYAN'S PIT AND EAST TRENCHES PLUME STUDY AREAS

PROJ. NO.	774115	DWG. NO.	4115B001	SHEET 1 OF 3
DESIGN BY	DRG	CHECKED	xx	
DRAWN BY	JDL	APPROVED	xx	
DATE	1-21-98	SCALE	1:400	

DEN\CADD\4115B001.DWG 2-4-98 JDL



LEGEND

- LAKES AND PONDS
- VOC GROUNDWATER PLUME (> TIER II) (RMRS, 1997b)
- VOC GROUNDWATER PLUME (> TIER I) (RMRS, 1997b)
- PCM 8 / PCE U / TCE 0.8 — VOC CONCENTRATIONS IN GROUNDWATER, 1996 MAXIMUM, ug/L (RMRS, 1997b)
- STREAMS AND DITCHES
- 25 FOOT CONTOUR
- 5 FOOT CONTOUR
- FENCE OR OTHER BARRIER
- PAVED ROAD
- DIRT ROAD
- ⊕ 00898 — PLANNED WELL LOCATION
- ⊕ 00991 — EXISTING DATA LOCATION

NOTE: PCM = CARBON TETRACHLORIDE (PERCHLORMETHANE) U = NOT DETECTED
PCE = TETRACHLOROETHENE (PERCHLOROETHYLENE)
TCE = TRICHLOROETHENE

GRAPHIC SCALE
0 25 50 100
(IN FEET)
1 inch = 100 ft.

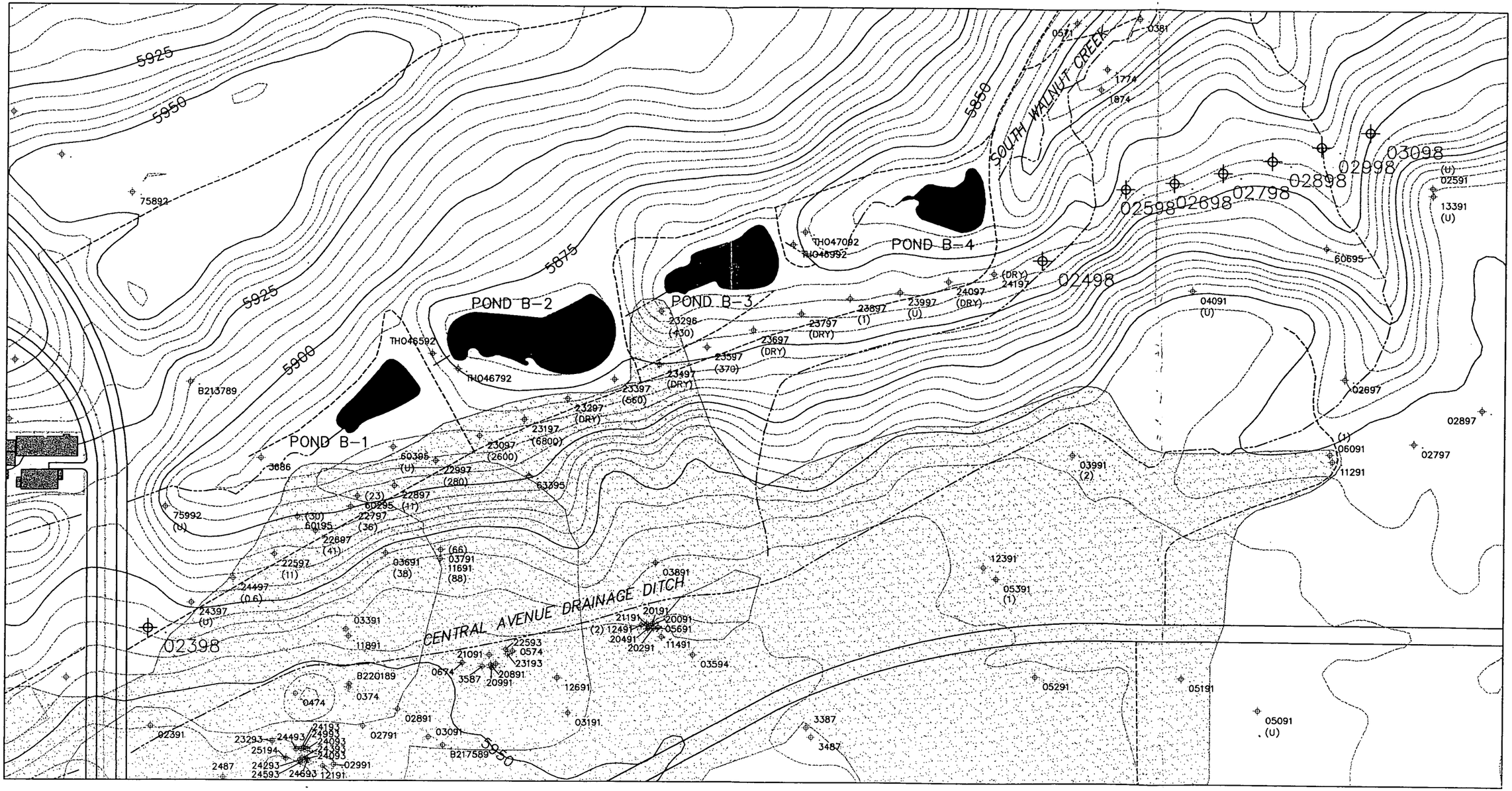
PREPARED FOR:
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
Golden, Colorado

FIGURE 2

TITLE:
903 PAD/RYAN'S PIT PLUME STUDY AREA

PROJ. NO.	774115	DWG. NO.	4115B003	SHEET 2 OF 3
DESIGN BY	ZT	CHECKED	xx	
DRAWN BY	JDL	APPROVED	xx	
DATE	1-21-98	SCALE	1:100	

DEN\CADD\4115B003.DWG 2/5/98 JDL



LEGEND

- LAKES AND PONDS
- VOC GROUNDWATER PLUME (>TIER II) (RMRS, 1997b)
- VOC GROUNDWATER PLUME (> TIER I) (RMRS, 1997b)
- STREAMS AND DITCHES
- 25 FOOT CONTOUR
- 5 FOOT CONTOUR
- FENCE OR OTHER BARRIER
- PAVED ROAD
- DIRT ROAD
- 02498 — PLANNED WELL LOCATION
- 05291 — EXISTING DATA LOCATION
- (41) — TRICHLOROETHENE CONCENTRATION IN GROUNDWATER, 1997, ug/L
- NOTE: U = NOT DETECTED

GRAPHIC SCALE
0 50 100 200
(IN FEET)
1 inch = 200 ft.

PREPARED FOR:
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
Golden, Colorado

FIGURE 3

TITLE:
EAST TRENCHES PLUME STUDY AREA

PROJ. NO.	774115	DWG. NO.	4115B002	SHEET 3 OF 3
DESIGN BY	ZT	CHECKED	xx	
DRAWN BY	JDL	APPROVED	xx	
DATE	1-22-98	SCALE	1:200	

DEN\CADD\4115B002.DWG 2/5/98 JDL